Data Manipulation

Pipelining

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Electric pulses

- ✓ Electric pulses travel through wire no faster than the speed of light.
- ✓ Since light travels 1 foot in a nanosecond (one billionth second)
- ✓ CPU requires at least 2 nanosecond to fetch the instruction from memory.
- ✓ Read request to memory and

Pipelining

Throughp

- **H**Fetching, decoding and executing requires several nano-second.
- Increasing execution speed is not the only way to increase the CPU throughput (The amount of work done by a machine in a given time)

Pipelining

Increasing Throughput

- ✓ Increasing throughput without increasing the speed is achieved through Pipelining.
- ✓ Allow steps in machine cycle to overlap.

Pipelining

Pipelining vs without Pipelining

Pipelining			
Time	Fetch	Decode	Execute
T1	1		
T2	2	1	
T3	3	2	1
T4	4	3	2
T5	5	4	3
T6		5	4
T7			5

Without PipeLinie			
Time	Fetch	Decode	Execute
T1	1		
T2		1	
T3			1
T4	2		
T5		2	
T6			2
T7	3		
T8		3	
T9			3
T10	4		
T11		4	
T12			4
T13	5		
T14		5	
T15			5

Pipelining

Modern Machines

- ✓ Modern Machines are even able to fetch several instructions at one time.
- ✓ Even execution of instructions at one given time when the instructions are not rely on each other.

Summary

Pipelining

- ✓ Increasing Throughput of Computer
- ✓ Pipelining concept
- ✓ Examples
- ✓ Modern computers characteristics